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Observations on *Megaphragma mymaripenne* Timberlake (Hymenoptera: Trichogrammatidae), an egg parasite of *Heliothrips haemorrhoidalis* Bouché (Thysanoptera: Thripidae)

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Abstract.—Preliminary biological studies were conducted on the trichogrammatid, *Megaphragma mymaripenne* Timberlake, a native egg parasite of the greenhouse thrips in California. The searching and oviposition behavior of this parasite are described. Although only uniparental reproduction was observed in the laboratory, one male was collected from the field, suggesting the occurrence of deuterotoky. The time required for development from egg to adult averaged 41.4 days. Thrips parasitization was estimated by taking monthly leaf samples from an avocado orchard in Santa Barbara County and one in Orange County, and recording numbers of thrips "egg blisters" showing emergence of thrips, of the parasite, or no emergence. Egg blisters showing evidence of parasitization ranged from 22–41% and 3–51% in the Santa Barbara and Orange County orchards, respectively. In both locations, highest parasitization occurred in the months of November and January.

The greenhouse thrips, *Heliothrips haemorrhoidalis* Bouché, is one of the major pests of avocado in California (Boyce and Mabry 1937, Ebeling 1959). Feeding by thrips on the fruit causes a brown scarring on the surface that results in reduced market value.

Few natural enemies have been reported for this pest (Boyce and Mabry 1937, Ebeling 1959, McMurtry 1961, McMurtry and Johnson 1963, Lewis 1973, Mound and Walker 1982, Ananthakrishnan 1984). The trichogrammatid, *Megaphragma mymaripenne* Timberlake, was first reported as a parasite of greenhouse thrips in California by Boyce and Mabry (1937). McMurtry and Johnson (1963) and Ebeling (1959) noted that the parasite sometimes attacks a high percentage of greenhouse thrips eggs, but it was not known whether it had a controlling effect. Taxonomic reports on *M. mymaripenne* include those of Timberlake (1923), Ghesquiére (1939), Doutt and Viggiani (1968), and Rao (1969). Doutt and Viggiani (1968) stated that *M. mymaripenne* is probably the smallest of all insect species. No information was available concerning its biology, effect as a controlling agent, or on how to culture it in the laboratory.

To better understand this parasite and its impact on thrips populations, preliminary biological studies were conducted in the laboratory, and field observations on percentage parasitization of *H. haemorrhoidalis* were made in two different localities.

Materials and Methods

Cultures were maintained and biological studies were conducted in the laboratory at 22–23°C and 10–42% RH. In order to culture *M. mymaripenne,* avocado leaves were placed in stainless steel pans, upper side up, on plastic foam pads soaked with distilled water. The leaves were bordered with strips of cellucotton® to reduce leaf dehydration and prevent the escape of thrips or parasites. Twenty field-collected adults of the greenhouse thrips were placed on each leaf. Three days later, five adult parasites that emerged from egg blisters on field-collected leaves were placed on the infested leaves.

A similar technique was used for biological studies of the parasite except that only one adult parasite was placed on each of 15 leaves. Egg blisters of the greenhouse thrips that were stung by the parasite were marked and dated. Behavior of the adults and developmental time was observed and recorded. Some adult parasites were occasionally mounted in Hoyer's media to determine their sex (presence or absence of an ovipositor).

Seasonal activity of the greenhouse thrips and the parasite were monitored in an unsprayed avocado orchard at Santa Barbara and a similar orchard on the University of California's South Coast Field Station, Irvine. The Santa Barbara orchard was surveyed from June, 1984, until May, 1985; the South Coast Field Station orchard from June, 1985 to May, 1986. Both orchards contained various varieties and hybrids previously used in breeding studies. A sample of 100 leaves was collected randomly from infested avocado trees from both orchards monthly. Ten infested leaves were taken from each sample to determine the percentage of emergence of both thrips and parasite. These leaves were placed dorsal side up on foam pads soaked in distilled water. An area of 2 cm^2 containing egg blisters of the thrips was marked on each leaf. Egg blisters were marked with different colors according to whether they showed no exit holes, thrips exit holes (evidenced by part of the egg chorion at the side of the blister), or parasite exit holes (large, round holes, usually in the middle of the blisters). Percentage of thrips and parasite emergence was calculated when leaves were brought from the field. Any subsequent emergence was determined by weekly examination of the egg blisters, previously showing no emergence of thrips or parasites.

Results and Discussion

Observations on the biology of M. mymaripenne:

After emergence from the thrips egg blister, the adult parasites took about 45–60 minutes to clean their bodies before starting to search for hosts and oviposit. No mating was observed. All 20 adults that were mounted from the culture were females.

Even though uniparental reproduction was observed in the laboratory, one male was collected from the field, indicating that *M. mymaripenne* occasionally exhibits deuterotoky. Like some other trichogrammatids, uniparental reproduction normally occurs but an occasional male is produced (Clausen 1956). Flanders (1945) stated that uniparental bisexuality probably is due to environmental factors such as type of habitat, season, temperature or nutrition. He reported that females of many hymenopterous species, influenced by environmental conditions, produce two kinds

of eggs; one yielding only uniparental females and another either uniparental or, if fertilized, biparental females.

The thrips fecal material seemed to be one of the main factors for illiciting probing or oviposition responses by the female. Dried fecal material sometimes induced a brief probing or oviposition response. However, egg blisters without fecal material were sometimes stung.

Before ovipositing, the female walked around the egg blister searching with her antennae for the softer exposed parts where stinging usually occurred. Eggs that were completely covered with fecal material were also stung, but a longer time was required. Of the 14 individuals observed, oviposition time ranged from 0.5–7.5 min., average, 3.2 min. No parasites emerged when oviposition time was less than 2.5 min. One adult female oviposited in eight egg blisters in 30 min. Another one took about two hours to oviposit in the same number of egg blisters, with intervals of drinking water and cleaning its body. During oviposition, the adult female puts its weight mainly on the hind legs and the wings, curving its abdomen forward and then inserting the ovipositor into the side or sometimes in the middle of the egg blister. The same egg blister was occasionally stung again by the same or a different parasite, suggesting the occurrence of superparasitism. After ovipositing in several egg blisters, the adult female cleaned her body and then walked or flew to another part of the leaf, where she resumed searching.

The developmental time (egg to adult) of 18 *M. mymaripenne* ranged from 36–46 days; average 41.4 days. Under similar conditions, the greenhouse thrips has a shorter developmental period, with a range of 24–36 days for 80 individuals, averaging 31 days (Hessein and McMurtry, unpubl.). Adult parasites lived approximately 48 hr. Adult thrips longevity ranged from 20–58 days, averaging 40.6 days for 24 individuals. The long time required for the parasite to complete its development might limit its ability to suppress increasing populations of thrips.

Parasitization by M. mymaripenne *at two field sites:*

In Santa Barbara (Table 1), the percentage emergence of thrips larvae from egg blisters varied from 20.2–42.2%; average 32.1%. The highest percentages occurred in November, 1984, and January, 1985. The percentage emergence of the parasite varied from 21.7–41.1%; average 33.4%. As with the greenhouse thrips, the highest percentages occurred in November, 1984, and January, 1985. There was always a substantial percentage (average 34.5%) of egg blisters from which neither thrips nor parasites emerged. Because the age of the egg blisters or the time of emergence cannot be determined on field-collected leaves, emergence in the laboratory may give a better indication of present activity. Parasite and thrips emergence was comparable except for August, December, February, and May, when the percentage of thrips emergence was distinctly higher than that of the parasite.

At the South Coast Field Station, the thrips emergence was generally higher and parasite emergence lower, compared to Santa Barbara. The percentage emergence of thrips larvae from egg blisters varied from 28.9–63.5%; average 41.7%. The percentage emergence of parasites varied from 3.2–51.0%; average 21.4%. The highest percentages occurred in November, 1984, and January, 1986. The average percentage of egg blisters from which neither thrips or parasites emerged (35.3%) was similar to that at Santa Barbara. Percentage emergence in the laboratory was

Table 1. Percentage emergence of the greenhouse thrips, *Heliothrips haemorrhoidalis* Bouché, and its egg parasite, *Megaphragma mymaripenne* Timberlake, from infested avocado leaves collected at Santa Barbara, 1984–1985.

	% Thrips Emergence			% Parasite Emergence			% No
Month	Field	Laboratory	Total	Field	Laboratory	Total	emergence
June *1984*	16.5	8.0	24.5	28.3	9.1	37.4	38.1
July	26.4	2.6	28.9	32.3	2.9	35.2	35.9
August	27.3	6.7	34.0	24.7	2.5	27.3	38.8
September	30.4	7.2	37.6	29.8	5.6	35.4	27.0
October	18.9	1.3	20.2	37.2	1.6	38.8	41.0
November	36.3	4.1	40.4	33.7	7.4	41.1	18.5
December	25.2	12.1	37.2	23.4	6.0	29.4	33.3
January *1985*	28.2	14.1	42.2	27.4	11.9	39.3	18.5
February	27.3	8.4	35.6	28.1	2.1	30.2	34.1
March	24.9	2.5	27.4	30.5	3.2	33.7	39.0
April	22.9	1.9	24.8	28.1	2.9	31.0	44.2
May	28.1	4.6	32.7	20.8	0.9	21.7	45.6
Mean	26.0	6.1	32.1	28.7	4.7	33.4	34.5

Table 2. Percentage emergence of the greenhouse thrips, *Heliothrips haemorrhoidalis* Bouché, and its egg parasite, *Megaphragma mymaripenne* Timberlake, from infested avocado leaves collected at the South Coast Field Station, Orange County, 1985–1986.

	% Thrips Emergence			% Parasite Emergence			% No
Month	Field	Laboratory	Total	Field	Laboratory	Total	emergence
June *1985*	50.8	7.4	58.2	12.7	0.5	13.2	29.1
July	25.0	7.4	32.4	13.0	3.1	16.1	51.5
August	35.6	6.1	61.7	2.9	0.3	3.2	35.1
September	54.4	4.5	58.8	2.6	0.8	3.4	37.7
October	39.6	2.8	42.4	9.0	4.4	13.4	44.2
November	18.3	10.6	28.9	43.3	7.7	51.0	20.2
December	31.9	3.5	35.4	28.1	8.7	36.8	27.8
January *1986*	30.0	2.6	32.5	37.3	9.7	46.7	20.5
February	40.6	2.9	43.5	15.3	2.6	17.9	38.5
March	30.9	3.5	34.3	20.7	2.5	23.3	42.4
April	25.0	4.2	29.2	10.6	2.2	12.8	58.1
May	48.9	14.6	63.5	11.4	6.7	18.1	18.4
Mean	35.9	5.8	41.7	17.2	4.1	21.4	35.3

usually higher for thrips than for parasites but the reverse was true in October, December and January.

Both of these orchards had heavy infestations of greenhouse thrips in the areas sampled but the populations were consistently higher at the South Coast Field Station orchard. Although parasitization by *M. mymaripenne* was higher in the Santa Barbara orchard, our observations suggest that percent parasitization did not increase proportionally with thrips population density to effect a decline in thrips populations. Therefore, it appears doubtful that this parasite, by itself, is a regulating factor of thrips populations in California.

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